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INVOLUTE REFLECTOR PLATE
[INBORYUUTOGATA HANSHABAN]

SHIGENAO MARUYAMA

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INVENTOR(S)	(72):	Shigenao Maruyama
APPLICANT(S)	(71):	Keikoo K.K. Shigenao Maruyama
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Specification

[Claims]

[Claim 1]

An involute reflector plate installed so as to cover a cylindrical radiant source and shaped such that a cross-section of the reflector plate normal to the central axis of said cylindrical radiant source extends from a single initial point on the external circumference of the above-mentioned radiant source in a bilaterally symmetrical manner in an involute curve shape generated from said circumference and a straight line joining the two side edges thereof nearly touches the above-mentioned external circumference,

wherein the above-mentioned involute curve is shaped by trimming away a predetermined amount in the vicinity of the initial point and the above-mentioned radiant source is brought in proximity to said reflector plate at most up to the point of bringing it into contact with the reflector plate in the direction connecting the central axis of the radiant source and the above-mentioned initial point.

[Claim 2]

The involute reflector plate according to claim 1, wherein the predetermined amount trimmed in the vicinity of the above-mentioned initial point constitutes at most 20% of the diameter of the radiant source.

[Claim 3]

An involute reflector plate obtained by interconnecting a plurality of involute reflector plates shaped by trimming away a predetermined amount in the vicinity of the side edges of the above-mentioned involute curves in a reflector plate installed so as to cover a cylindrical radiant source and shaped such that a cross-section of the reflector plate normal to the central axis of said cylindrical radiant source extends from a single initial point on the external circumference of the above-mentioned radiant source in a bilaterally symmetrical manner in an involute curve shape generated from said circumference and a straight line joining the two side edges thereof nearly touches the above-mentioned external circumference.

[Claim 4]

An involute reflector plate installed so as to cover a cylindrical radiant source and shaped such that a cross-section of the reflector plate normal to the central axis

of said cylindrical radiant source extends from a single initial point on the external circumference of the above-mentioned radiant source in a bilaterally symmetrical manner in an involute curve shape generated from said circumference and straight lines joining the two side edges thereof nearly touch the above-mentioned external circumference,

wherein reflective surfaces are provided in a plane perpendicular to the direction of the straight line joining the above-mentioned two side edges at the extreme outer edges corresponding to said trimmed locations of the involute reflector plate constituting the extreme outer edges in an involute reflector plate shaped by trimming away a predetermined amount in the vicinity of the side edges of the above-mentioned involute curves or in an involute reflector plate according to claim 3.

[Claim 5]

The involute reflector plate according to claim 3 or 4, wherein the predetermined amount trimmed in the vicinity of the above-mentioned two side edges is such that the distance between the two side edges obtained after trimming away said predetermined amount in the vicinity of the two side edges constitutes at least 80% of the distance between the two side edges prior to said trimming.

[Claim 6]

An involute reflector plate installed so as to cover a cylindrical radiant source and shaped such that the cross-section of the reflector plate normal to the central axis of said cylindrical radiant source extends from a single initial point on the external circumference of the above-mentioned radiant source in a bilaterally symmetrical manner in an involute curve shape generated from said circumference and a straight line joining the two side edges thereof nearly touches the above-mentioned external circumference,

wherein the diameter of the radiant source is expanded by a predetermined amount in comparison with the diameter of the circumference, from which the above-mentioned involute curves are generated.

[Claim 7]

The involute reflector plate according to claim 6, wherein the predetermined amount of expansion of the above-mentioned diameter is at most 20% of the diameter of the external circumference.

[Claim 8]

An involute reflector plate produced by interconnecting a plurality of involute reflector plates

according to claim 1 or 6 installed in the above-mentioned cylindrical radiant sources.

[Claim 9]

The involute reflector plate according to any one of claims 1, 3, 6, or 8, which is shaped so as to cover cylindrical radiant sources whose central axes are connected in an annular [*sic; possible typographical error – trans.*] fashion and be connected in a linear fashion.

[Detailed Description of the Invention]

[0001]

[Field of Industrial Applicability]

The present invention relates to an involute reflector plate that efficiently reflects radiation emitted from cylindrical radiant sources, such as radiation emitted from the cylindrical surfaces of fluorescent tubes, etc., as well as infrared rays emitted from cylindrical incandescent sources.

[0002]

[Prior Art]

Conventional reflector plates used for illumination as well as reflector plates of radiator stoves and the like include cylindrical reflector plates, in which the cross-section of the reflective surface has a near-circular shape, and paraboloid reflector plates, in which the reflective

surface is quasi-paraboloid in shape. Called “imaging reflectors”, such reflector plates are capable of forming images from point light sources or point radiant sources. The above-mentioned imaging reflectors are effective when the light sources or radiant sources are point or linear sources. However, in actual practice, many light sources and radiant sources are cylinders of limited diameter. When the above-mentioned cylindrical reflector plates and paraboloid reflector plates are used, some of the light (diffused light) emitted from an emitter in all directions through a full circle is reflected by such a cylindrical reflector plate or paraboloid reflector plate and blocked by said emitter. Consequently, the distribution of light or heat radiation in the aperture portion portion, through which the light or radiation emitted from the emitter is released, becomes non-uniform both in terms of intensity and direction, thereby causing degradation in the overall efficiency of reflection.

[0003]

Thus, the present applicants have previously filed an application (Japanese Unexamined Patent Application Publication No. Hei 2-417706) for an involute reflector plate, in which radiation emitted from said radiant source is emitted from the aperture portion in a completely

homogenous manner without being blocked, efficiency is greatly improved, and furthermore, homogeneous radiation is obtained. Specifically, this is an involute reflector plate shaped in such a manner that it [*sic; – trans.*] extends from a single initial point on the external circumference of a cylindrical or spherical radiant source in a bilaterally symmetrical manner in the shape of involute curves and a straight line joining the two side edges thereof nearly touches the above-mentioned external circumference.

[0004]

Further, it allows for completely homogeneous intensity and isotropic radiation to be obtained in the aperture portion of the reflector plate when the reflective surface is an ideal reflective surface (100% reflectance) and the intensity of radiation from the surface of a cylindrical emitter is the same in all directions through a full circle.

[0005]

[Problems to be Solved by the Invention]

However, in an actual emitter, light or infrared rays are not radiated from its surface with equal intensity in all directions through a complete circle. As a result, when a conventional involute reflector plate is used, in

which the cross-section of the reflector plate perpendicular to the central axis of the cylindrical radiant source extends from a single initial point on the external circumference of the above-mentioned radiant source in a bilaterally symmetrical manner in an involute curve shape generated from said circumference, streak-like dark portions appear in the vicinity of the above-mentioned initial point of the involute reflector plate, as a result of which a completely homogeneous radiant surface cannot be produced in the aperture portion of the reflector plate.

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[0006]

On the other hand, due to the fact that the distal end portion of said initial point has a cusp-shaped distal end whose angle and thickness tend to zero, the manufacture of the reflector plate, during which the reflector plate is fabricated by drawing, extrusion molding, and similar techniques, is extremely difficult and results in high fabrication costs. In addition, if the shape is cusp-like, the strength of the plate decreases and it becomes difficult to obtain sufficient strength in a fabricated reflector plate.

[0007]

Further, when the reflectance of the reflector plate is 100%, an involute reflector plate allows for creating a homogeneous radiant surface in the aperture portion of the reflector plate. However, in case of actual reflective surfaces, such as metal plated surfaces, areas of somewhat lower radiant intensity are present at the two side edges of the aperture portion and it is difficult to create a homogeneous radiant surface in the vicinity of the two side edges of the aperture portion.

[0008]

The present invention, which was made with account taken of the above-described prior-art, is an involute reflector plate installed so as to cover a radiant source that does not radiate light or infrared rays from its surface equally in all directions through a complete circle. In this involute reflector plate, improvements are made in the vicinity of the initial point of the of the involute reflector plate as well as in the vicinity of the two side edges of the aperture portion in order to enable efficient emission of radiation and light from the above-mentioned radiant source and obtain a uniform and isotropic radiant surface in the aperture portion.

[0009]

[Means for Solving the Problems]

Accordingly, the present invention provides a reflector plate installed so as to cover a cylindrical radiant source and shaped such that a cross-section of the reflector plate normal to the central axis of said cylindrical radiant source extends from a single initial point on the external circumference of the above-mentioned radiant source in a bilaterally symmetrical manner in an involute curve shape generated from said circumference and a straight line joining the two side edges thereof nearly touches the above-mentioned external circumference, wherein the above-mentioned involute curve is shaped by trimming away a predetermined amount in the vicinity of the initial point and the above-mentioned radiant source is brought in proximity to said reflector plate at most up to the point of bringing it into contact with the reflector plate in the direction connecting the central axis of the radiant source and the above-mentioned initial point.

[0010]

It should be noted that the predetermined amount trimmed in the vicinity of the above-mentioned initial point should constitute at most 20% of the diameter of the radiant source. Further, the invention according to claim

3 is an involute reflector plate obtained by interconnecting a plurality of involute reflector plates shaped by trimming away a predetermined amount in the vicinity of the side edges of the above-mentioned involute curves in a reflector plate installed so as to cover a cylindrical radiant source and shaped such that a cross-section of the reflector plate normal to the central axis of said cylindrical radiant source extends from a single initial point on the external circumference of the above-mentioned radiant source in a bilaterally symmetrical manner in an involute curve shape generated from said circumference and a straight line joining the two side edges thereof nearly touches the above-mentioned external circumference.

[0011]

Further, the invention according to claim 4 is an involute reflector plate installed so as to cover a cylindrical radiant source and shaped such that a cross-section of the reflector plate normal to the central axis of said cylindrical radiant source extends from a single initial point on the external circumference of the above-mentioned radiant source in a bilaterally symmetrical manner in an involute curve shape generated from said circumference and straight lines joining the two side edges

thereof nearly touch the above-mentioned external circumference, wherein reflective surfaces are provided in a plane perpendicular to the direction of the straight lines joining the above-mentioned two side edges at the extreme outer edges corresponding to said trimmed locations of the involute reflector plate constituting the extreme outer edges in an involute reflector plate shaped by trimming away a predetermined amount in the vicinity of the side edges of the above-mentioned involute curves or in an involute reflector plate according to claim 3.

[0012]

It should be noted that the predetermined amount trimmed in the vicinity of the two side edges should be such that the distance between the two side edges obtained after trimming away said predetermined amount in the vicinity of the two side edges constitutes at least 80% of the distance between the two side edges prior to said trimming. Further, the invention according to claim 6 is an involute reflector plate installed so as to cover a cylindrical radiant source and shaped such that the cross-section of the reflector plate normal to the central axis of said cylindrical radiant source extends from a single initial point on the external circumference of the above-mentioned radiant source in a bilaterally symmetrical

manner in an involute curve shape generated from said circumference and a straight line joining the two side edges thereof nearly touches the above-mentioned external circumference, wherein the diameter of the radiant source is expanded by a predetermined amount in comparison with the diameter of the circumference, from which the above-mentioned involute curves are generated.

[0013]

It should be noted that the predetermined amount of expansion of the above-mentioned diameter should constitute at most 20% of the diameter of the external circumference. Further, it is possible to interconnect a plurality of involute reflector plates, in which the above-mentioned involute curve is shaped by trimming away a predetermined amount in the vicinity of the initial point and the above-mentioned radiant source is brought in proximity to said reflector plate at most up to the point of bringing it into contact with said reflector plate in the direction connecting the central axis of the radiant source and the above-mentioned initial point, or involute reflector plates, in which the diameter of the above-mentioned radiant source is expanded by a predetermined amount in comparison with the diameter of the circumference, from which the above-mentioned involute curves are generated.

[0014]

Further, it may be shaped so as to cover cylindrical radiant sources whose central axes are connected in an annular fashion and be connected in a linear fashion.

[0015]

[Operation]

Based on such a configuration, using a reflector plate installed so as to cover a cylindrical radiant source and shaped such that a cross-section of the reflector plate normal to the central axis of said cylindrical radiant source extends from a single initial point on the external circumference of the above-mentioned radiant source in a bilaterally symmetrical manner in an involute curve shape generated from said circumference and a straight line joining the two side edges thereof nearly touches the above-mentioned external circumfer makes it possible to efficiently emit light or radiation emitted from the above-mentioned radiant source and obtain a uniform and isotropic radiant surface even if the above-mentioned radiant source is a radiant source that does not radiate light or infrared rays from its surface with equal intensity in all directions through a complete circle or, furthermore, if areas of somewhat lower radiant intensity are present at the two side edges of the aperture portion, as is the case

with actual real reflective surfaces. The operation of the reflector plate is described below.

[0016]

[Working Examples]

Below, the present invention is explained in detail with reference to the accompanying drawings. What is shown in FIG. 1 illustrates a first working example of the present invention, in which the involute reflector plate of the present invention is applied to a luminaire. In the figure, a fluoresent tube 5, which is a cylindrical radiant source, is attached to the main body of a luminaire (not shown) using sockets, not shown. In addition, a reflector plate 8 of an involute cross-sectional configuration, which covers both sides and bottom portion of the fluorescent tube 5 and is open at the top, is attached thereto as well.

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[0017]

Here, the reflector plate 8 of an involute cross-sectional configuration is a shape extending from a single initial point on a reference circumference with a radius of r illustrated in FIG. 1, which represented by:

$$x = r\ (\omega\cos\omega - \sin\omega),$$

$$y = -r\ (\omega\sin\omega + \cos\omega + 1)$$

in XY coordinates having their point of origin on the reference circumference 1, in a bilaterally symmetrical manner in an involute curve shape generated from said circumference. Here, ω is a variable related to the involute curves. It ranges from $-\pi$ to π and when if $\omega=0$, the point K on the reference circumference 1 is the initial point.

[0018]

More specifically, if $\omega=\pi$, then $x=-r$, $y=0$, and the point is at A in the drawing, and if $\omega=-\pi$, then $x=r$, $y=0$, and the point is at A' in the drawing. Here, in accordance with the configuration of the present invention, as shown in FIG. 2, the reflector plate 8 is shaped such that a predetermined amount k has been trimmed at point K on the reference circumference 1 and the right-hand reflector plate 8a and left-hand reflector plate 8b are interconnected by a flat plate 15 at points M and N. Furthermore, in the present application example, the above-mentioned predetermined amount constitutes 10% of the diameter d (=2r) of the reference circumference 1.

[0019]

Further, the fluorescent tube 5 (its central point G) is disposed at a location obtained by moving the above-mentioned reference circumference 1 along the y axis, i.e.

in a direction connecting the center C of the reference circumference 1 and the above-mentioned initial point K until said fluorescent tube 5 comes into contact with the above-mentioned flat plate 15. Further, in the present working example, the diameter f of the fluorescent tube 5 is made 10% larger than the diameter d of the above-mentioned reference circumference 1. Accordingly, in the present working example, the fluorescent tube 5 goes beyond the point of origin.

[0020]

Further, the involute reflector plate 8 is shaped by trimming away a predetermined amount s in the vicinity of the above-mentioned points A and A', with points E and E' serving as endpoints. In addition, in said working example, the above-mentioned predetermined amount s is determined such that the distance between the points E and E' on the two side edges upon trimming away said predetermined amount from the locations of the above-mentioned points A and A' constitute.s 95% of the distance ($2\pi r$) between the two side edges prior to said trimming.

[0021]

Further, in this first working example, plane mirrors 11, 12 with specular surfaces 11a, 12a are disposed facing towards the center at points E and E' on the two side edges

of the right-hand reflector plate 8a and left-hand reflector plate 8b of the involute reflector plate 8 such that they are aligned along the y axis in a plane perpendicular to the plane AOA', i.e.the aperture plane of the involute reflector plate 8, thereby providing reflective surfaces in a plane perpendicular to the said plain AOA'. It should be noted that the length of the plane mirrors 11 and 12 is such that they extend from the points E and E' on the above-mentioned two side edges all the way to the aperture plane AOA', with the points of intersection between the specular surfaces 11a, 12a of said plane mirrors 11, 12 and the x axis located at points B and B'.

[0022]

Next, a description will be given of the operation of the first working example. As described in Japanese Unexamined Patent Application Pub. No. Hei 02-041706, when there is a radiant source present in the reference circumference 1, a radiant flux emitted from a single point R on the reference circumference 1 is emitted from the system by passing through the emission aperture plane AOA' without being blocked by the surface of the radiant source, i.e. of the reference circumference 1 [*sic; – trans.*].

[0023]

Although in FIG. 1 radiant energy is emitted in all directions from point P on the fluorescent tube 5 consituting a radiant surface, the diameter f of the fluorescent tube 5 is made larger than the above-mentioned reference circumference 1 and its location is shifted. In addition, the reflector plate 8 is shaped by trimming a predetermined amount away around the above-mentioned points A and A'. In other words, it is somewhat shifted relative to the ideal involute reflector plate, as a result of which a portion of the radiant energy emitted from point P on the fluorescent tube 5 is directed at said fluorescent tube 5, thereby decreasing the efficiency of emission to a certain extent.

[0024]

However, based on the above-described configuration, as shown in FIG. 3, the distribution of relative luminance, as viewed in the direction of the y axis in FIG. 1, becomes more uniform. Namely, in prior-art involute reflector plates (as indicated by the dashed line in FIG. 3), there was a cusp near the initial point, and, in addition, some non-uniformity in the distribution of luminance was produced by thickness etc. of the cover glass of the fluorescent tube 5. As a result of such influence, as

shown in FIG. 3, the luminance obtained at positions ($x/\pi r$) corresponding to about 0.3 and about 0.8 in the aperture of the reflector plate became extremely small (points H, I in FIG. 3). However, numerical calculation results have confirmed that luminance is greatly improved (points H' and I' in FIG. 3) by trimming away a predetermined amount k from the reflector plate 8 in the vicinity of point K on the reference circumference 1, disposing the fluorescent tube 5 in a location shifted such that it comes into contact with the flat plate 15, and furthermore, expanding the diameter f of the fluorescent tube 5.

[0025]

Further, since areas of somewhat lower radiant intensity are present at the two side edges of the aperture on a real reflective surface, such as a metal-plated surface, in case of a real reflector plate, when the reflector plate aperture position ($x/\pi r$) is approximately 1.0, luminance becomes extremely low and approaches 0.5 or so (as shown in FIG. 3 at point J). However, as confirmed by numerical calculation results, trimming away a predetermined portion of the reflector plate 8 in the vicinity of points A and A' to remove said low-luminance locations and, furthermore, disposing specular surfaces 11a, 12a at points E and E' at the two side edges of the

reflector plate 8 on the left-hand reflector plate 8b and right-hand reflector plate 8a is equivalent to providing another involute reflector plate 8 as an extension of said reflector plates 8a and 8b, thereby greatly improving luminance (point J' in FIG. 3).

[0026]

It should be noted that while the above-described numerical calculation results relate to a configuration, in which the above-mentioned predetermined amount k is set to 10% of the diameter d, the fluorescent tube 5, whose diameter f is made 10% larger in comparison with the reference circumference 1, is brought into contact with the above-mentioned flat plate 15, and, furthermore, the distance v between points E and E' on the two side edges obtained after trimming the predetermined amount s is set to 95% of the above-described [*sic; word missing – trans.*], before said results were obtained, calculations were carried out for various predetermined amounts, and said results are merely an example of a preferred predetermined amount.

[0027]

A description of the numerical calculation results associated with the various predetermined amounts used as examples of the predetermined amount is provided below.

Namely, the results shown in FIG. 4 – FIG. 5 illustrate the relationship between relative luminance, aperture position $x/\pi r$, and angle of sight θ, obtained by substituting various predetermined values for the predetermined amount. Here, to investigate the directional emission characteristics of radiant energy in the aperture, it is assumed that the relative luminance is relative radiant intensity obtained by dividing directional radiant intensity in the aperture by radiant intensity at the same angle at the radiant surface and the angle of sight is an angle relative to the point of origin O on the y axis. Further, in the drawings, the frontmost curve corresponds to $\theta = 0$ and the subsequent curves are drawn at 12° intervals.

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[0028]

FIG. 4 illustrates relative luminance associated with an involute reflector plate, in which the predetermined amount s is set to 0 and the two end sections have not been trimmed away. As can be appreciated from FIG. 4, in an involute reflector plate, in which the predetermined amount s is set to 0 and the two end sections have not been trimmed away, when $\theta = 0$, 12 and the reflector plate aperture position $(x/\pi r)$ is 1.0 and −1.0, i.e. at both ends,

the relative luminance becomes extremely low and a non-homogeneous radiant surface is formed at both ends of the reflector plate.

[0029]

On the other hand, FIG. 5 illustrates a case, in which the above-mentioned predetermined amount is set such that the above-mentioned distance v constitutes 95% of the distance between the two side edges prior to trimming, and it is clear that in this case the distribution of relative luminance at both ends is improved. At such time, the efficiency of emission η (=radiant energy emitted from aperture/radiant energy emitted from cylindrical radiant surface) is 91% (η=94% in case of FIG. 4).

[0030]

Further, FIG. 6 illustrates a case, in which the predetermined amount is set such that the above-mentioned distance v constitutes 83% of the distance between the two side edges prior to trimming. In this case, as can be seen from the drawing, the distribution of relative luminance is greatly improved. However, the efficiency of emission (η) is reduced to 80%. Accordingly, as evidenced by the numerical calculation results, it is preferable to set the predetermined amount s used for trimming the above-mentioned two side edges to a value, at which the distance

between the two side edges obtained after trimming a predetermined amount from the two side edges constitutes at least 80% of the distance between the two side edges prior to said trimming.

[0031]

Consequently, as explained above, by making improvements to the area of the initial point K of the involute reflector plate 8 and to the areas A and A' on the two side edges of the aperture makes it possible to efficiently ratiate light emitted from the above-mentioned fluorescent tube 5 serving as a radiant source and obtain a uniform and isotropic radiant surface in the aperture BOB'. Further, since the reflector plate 8 is shaped such that a predetermined amount k is trimmed therefrom in the vicinity of point K on the reference circumference 1, there is no cusp at the distal end of said initial point portion. This facilitates the fabrication of the reflector plate 8 and reduces the cost of fabrication. Further, in this first working example, using a flat plate 15 to link the left-hand reflector plate 8b with the right-hand reflector plate 8a provides for better strength and makes it possible to ensure the strength of the involute reflector plate 8.

[0032]

Further, as shown in FIG. 7, in a second working example of the present invention, three involute reflector plates, such as the one described above, are disposed and interconnected in parallel facing fluorescent tubes 35, 45, and 55, which serve as cylindrical radiant sources. Specifically, the involute reflector plate 31 is made up of a left-hand reflector plate 31a and a right-hand reflector plate 31b, and, in a similar manner, the involute reflector plates 41 and 51 are made up of 41a, 41b and 51a, 51b. Here, each one of the involute reflector plates 31, 41, and 51 has basically the same configuration as the involute reflector plate 8 described in the first working example of the present invention. However, the reflector plate 31b and reflector plate 41a are linked by a connecting portion 61 and, furthermore, the reflector plate 41b and reflector plate 51a are linked by a connecting portion 62. Further, plane mirrors 67, 68 with specular surfaces 67a, 68a are disposed facing towards the center in a plane perpendicular to the aperture plane 65 of the involute reflector plates 31, 41, and 51 at the two side edges 31, 52 of the reflector plate 31a and reflector plate 51b. It should be noted that the length of these plane mirrors 67, 68 is such that they extend from the above-mentioned two side edges 32,

52 all the way to the aperture plane 65, with the points of intersection between the specular surfaces 11a, 12a [*sic; must be* "67a, 68a" – *trans.*] of said plane mirrors 67, 68 and the aperture plane 65 located, respectively, at 33 and 53.

[0033]

In the second working example, in each of the involute reflector plates 31, 41, and 51, luminance is greatly improved by trimming away a predetermined amount k from the reflector plate, shifting the locations of the fluorescent tubes 35, 45, and 55 and expanding the diameters of the fluorescent tubes 35, 45, and 55. Further, as far as the influence of the areas of slightly lower radiant intensity at the two side edges is concerned, linking the involute reflector plates 31, 41, and 51 using the connecting portions 61 and 62 makes it possible to trim locations of smaller luminance and, furthermore, luminance is greatly improved by disposing plane mirrors 67, 68 at the two side edges 32, 52.

[0034]

In addition, in this working example, there are no cusps at the distal ends of the above-mentioned initial point portions, which facilitates the fabrication of the involute reflector plates 31, 41, and 51 and reduces the

cost of fabrication. Further, as is particularly clear from the second working example, this configuration, in which the overall combined height L of the involute reflector plates 31, 41, 51 and fluorescent tubes 35, 45, and 55 is reduced in comparison with the prior-art reflector plates, makes it possible to create luminares of high emission efficiency suitable for use in recessed lighting fixtures.

[0035]

Further, in the above-described working example, in a reflector plate that is installed so as to cover cylindrical heat sources instead of the fluorescent tube 5 and fluorescent tubes 35, 45, and 55, and reflects radiation from said heat sources, shaping the cross-section of the reflector plate, which is perpendicular to the central axes of the above-mentioned heat sources, such that it extends from initial points on the external circumferences of heat source cross-sections in a bilaterally symmetrical manner in the shape of involute curves generated from said circumferences and a straight line joining the two side edges nearly touches the above-mentioned circumferences, and, moreover, making improvements in areas in the vicinity of the two side edges of the aperture as well as in areas in the vicinity of the

initial points of the involute reflector plate will permit the same operation and effects as the ones described above and, on the other hand, will enable homogeneous warming of physical objects.

[0036]

Further, in the above-described working examples, the same operation and effects as those described above are produced if the cylindrical radiant sources, such as the fluorescent tube 5, as well as the fluorescent tubes 35, 45, and 55, are shaped such that their central axes are connected in an annular [*sic; possible typographical error – trans.*] fashion and the initial points of the cross-sections of the involute reflector plate 8, as well as those of 31, 41, and 51, are located in the vicinity of said contact points [*sic; no "contact points" have been mentioned – trans.*] in a plane tangent to said radiant sources in parallel to the plane comprising the central axes of the radiant sources.

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[0037]

[Effects of the Invention]

In accordance with the present invention, as described above, in an involute reflector plate installed so as to cover a cylindrical radiant source and shaped such that a

cross-section of the reflector plate normal to the central axis of said cylindrical radiant source extends from a single initial point on the external circumference of the above-mentioned radiant source in a bilaterally symmetrical manner in an involute curve shape generated from said circumference and a straight line joining the two side edges thereof nearly touches the above-mentioned external circumference, a predetermined amount k is trimmed from the involute reflector plate in the vicinity of the initial point, the radiant source is moved towards said involute reflector plate at most up to the point of coming into contact therewith, the diameter of the radiant source is expanded, and a predetermined amount is trimmed from the two side edges of the involute reflector plate, as a result of which, even if the radiant source is a radiant source that does not emit light or infrared radiation from its surface uniformly in all directions through a full circle, and even if areas of slightly lower radiant intensity are present at the two side edges of the aperture in case of an actual reflective surface, the light and radiation emitted from the above-mentioned radiant source can be efficiently emitted and a uniform and isotropic radiant surface can be obtained in the aperture while, at the same time, the fabrication of the involute reflector plate can be

facilitated and a reduction in the fabrication costs can be achived.

[Brief Description of the Drawings]

[FIG. 1]

A schematic cross sectional view of an involute reflector plate illustrating a first working example of the present invention.

[FIG. 2]

An enlarged view of the area in the vicinity of K in FIG. 1.

[FIG. 3]

A diagram of relative luminance distribution used to explain the operation and effects of the same working example.

[FIG. 4]

A diagram of relative luminance distribution used to explain the operation and effects of the same working example.

[FIG. 5]

A diagram of relative luminance distribution used to explain the operation and effects of the same working example.

[FIG. 6]

A diagram of relative luminance distribution used to explain the operation and effects of the same working example.

[FIG. 7]

A diagram of relative luminance distribution used to explain the operation and effects of the same working example.

[Description of Reference Numerals]

5. Fluorescent tube.

8. Involute reflector plate.

11. Plane mirror.

12. Plane mirror.

31. Involute reflector plate.

35. Fluorescent tube.

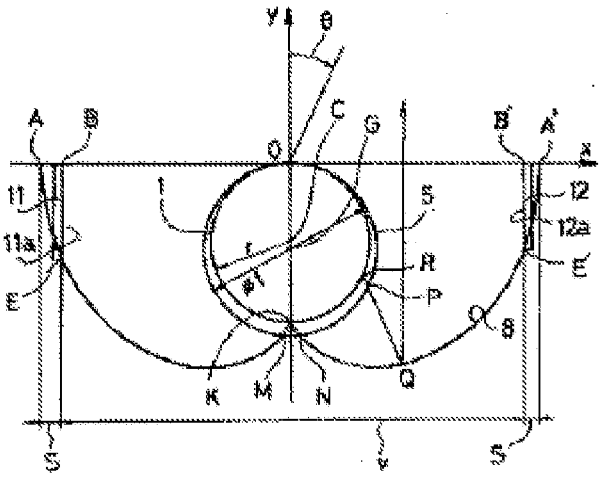
41. Involute reflector plate.

45. Fluorescent tube.

51. Involute reflector plate.

5. Fluorescent tube.

【図1】


y
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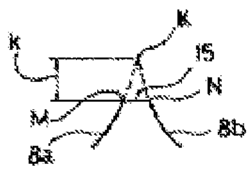
【図2】


K
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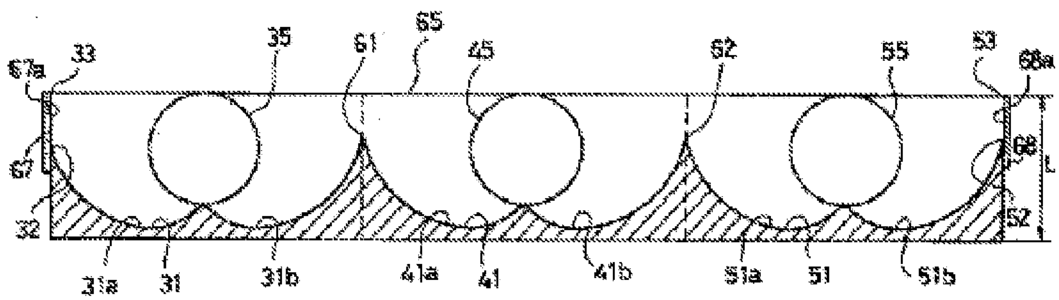
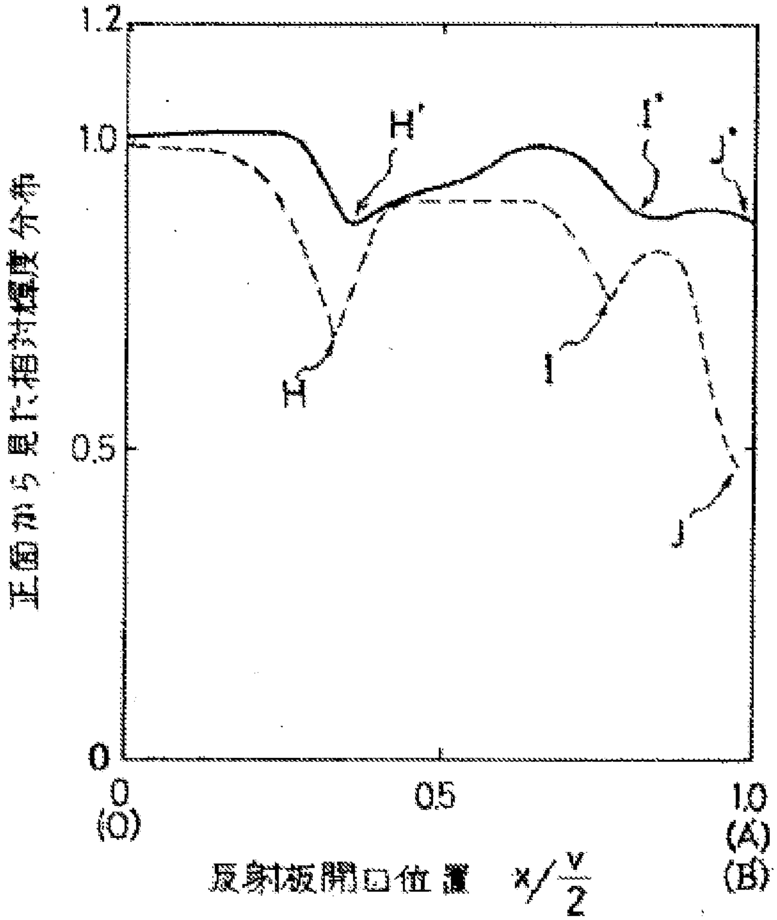
8a
8b

【図7】

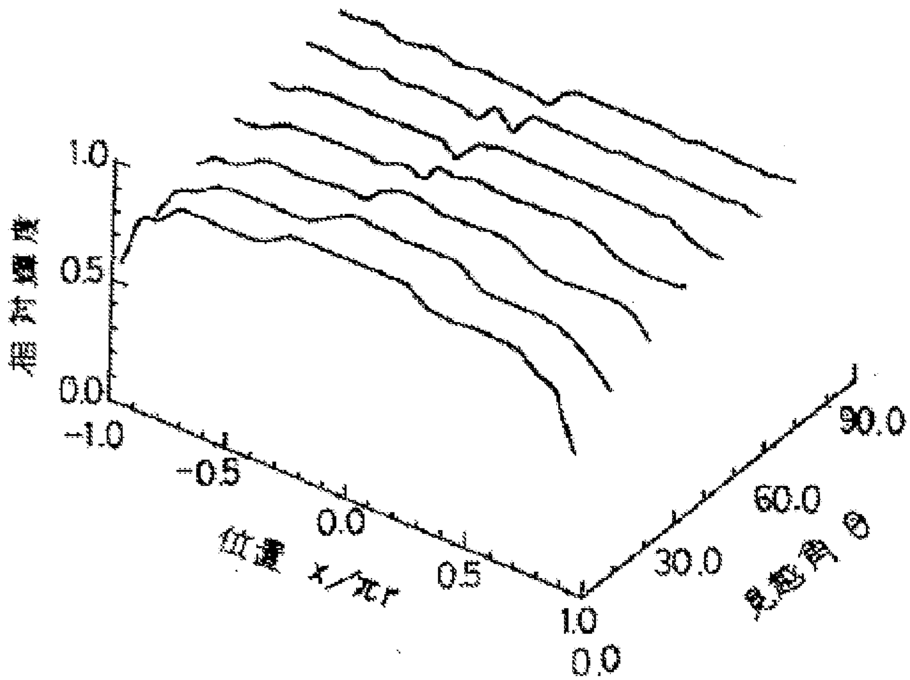

67a
33
35
61
65
45
62
55
53
68a
67
68
L
32
52
31a
31
31b
41a
41
41b
51a
51
51b



//Keys, FIG. 3//

(X-axis) Reflector aperture position.

(Y-axis) Relative luminance distribution (viewed from front)

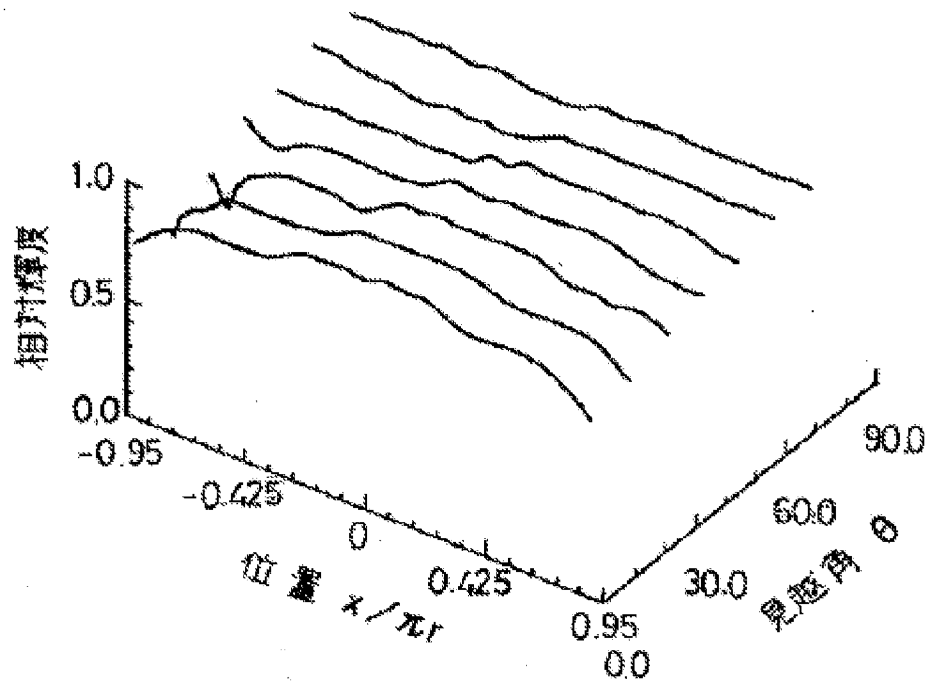


//Keys, FIG. 4//

(X-axis)   Position.

(Y-axis)   Relative luminance.

(Z-axis)   Angle of sight.

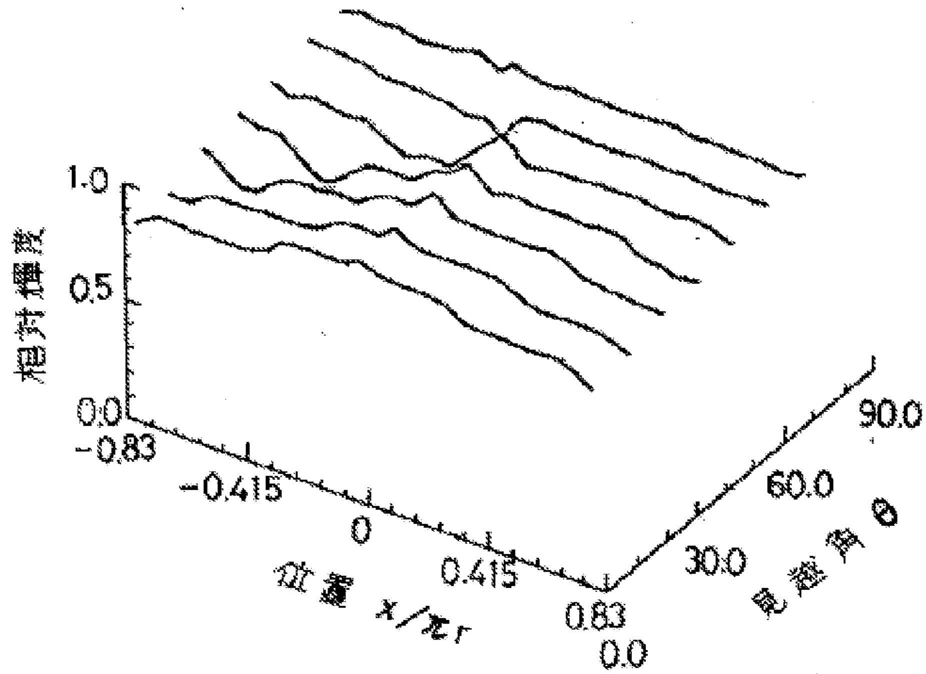


//Keys, FIG. 5//

(X-axis) Position.

(Y-axis) Relative luminance.

(Z-axis) Angle of sight.



//Keys, FIG. 6//

(X-axis) Position.

(Y-axis) Relative luminance.

(Z-axis) Angle of sight.